A Multi-Agent Architecture for 3D Rendering Optimisation

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Abstract

Rendering is the process of generating a 2D image from the abstract description of a 3D scene. In spite of the development of new techniques and algorithms, the computational requirements of photorealistic rendering are huge so that it is not possible to render them in real-time. In addition, the adequate configuration of rendering quality parameters is very difficult to be done by inexpert users, and they are usually set higher than in fact are needed. This paper presents an architecture called MAgaRO to optimise the rendering process in a distributed, non-centralised way through a multi-agent solution, by making use of expert knowledge or previous jobs in order to reduce the final rendering. Experimental results prove that this novel approach offers a promising research line to optimise the rendering of photorealistic images.

1 Introduction

The process of generating a 2D image comprises several phases such as modelling, setting materials and textures, placing virtual light sources, and finally rendering (Kerlow (2004)). Rendering algorithms take a description of geometry, materials, textures, light sources, and the virtual camera as input in order to produce an image or a sequence of images (in the case of animations) as output. There are different rendering algorithms ranging from simple and fast to complex and accurate that simulate the light behaviour in a precise way (Pharr and Humphreys (2004)). These methods are normally classified into two main categories (Goral et al. (1984)): local and global illumination algorithms.

High-quality photorealistic rendering of complex scenes is one of the key goals of Computer Graphics. Unfortunately this process is computationally intensive and requires a lot of time when the rendering technique simulates global illumination issues. Global illumination algorithms are known for their unpredictable data accesses and their computational complexity (Jensen (2004)). As pointed out by Kajiya (1986), all rendering algorithms aim at modelling the light behaviour over various types of surfaces and try to solve the rendering equation, which forms the mathematical basis for all rendering algorithms. Depending on the rendering method and the scene characteristics, the generation of a single high-quality image may take several hours (or even days!).

Because of the huge amount of time required, the rendering phase is often considered as a bottleneck in photorealistic projects in which one image may need hours of rendering in a modern workstation. For instance, Pixar’s famous animation movie Cars was estimated to spent 2300 CPU years by one of the technology manager of the studio. In other words, a single computer